

Instruction with Hands-on Practice: Creating a Bathymetric Database & Datum Conversion



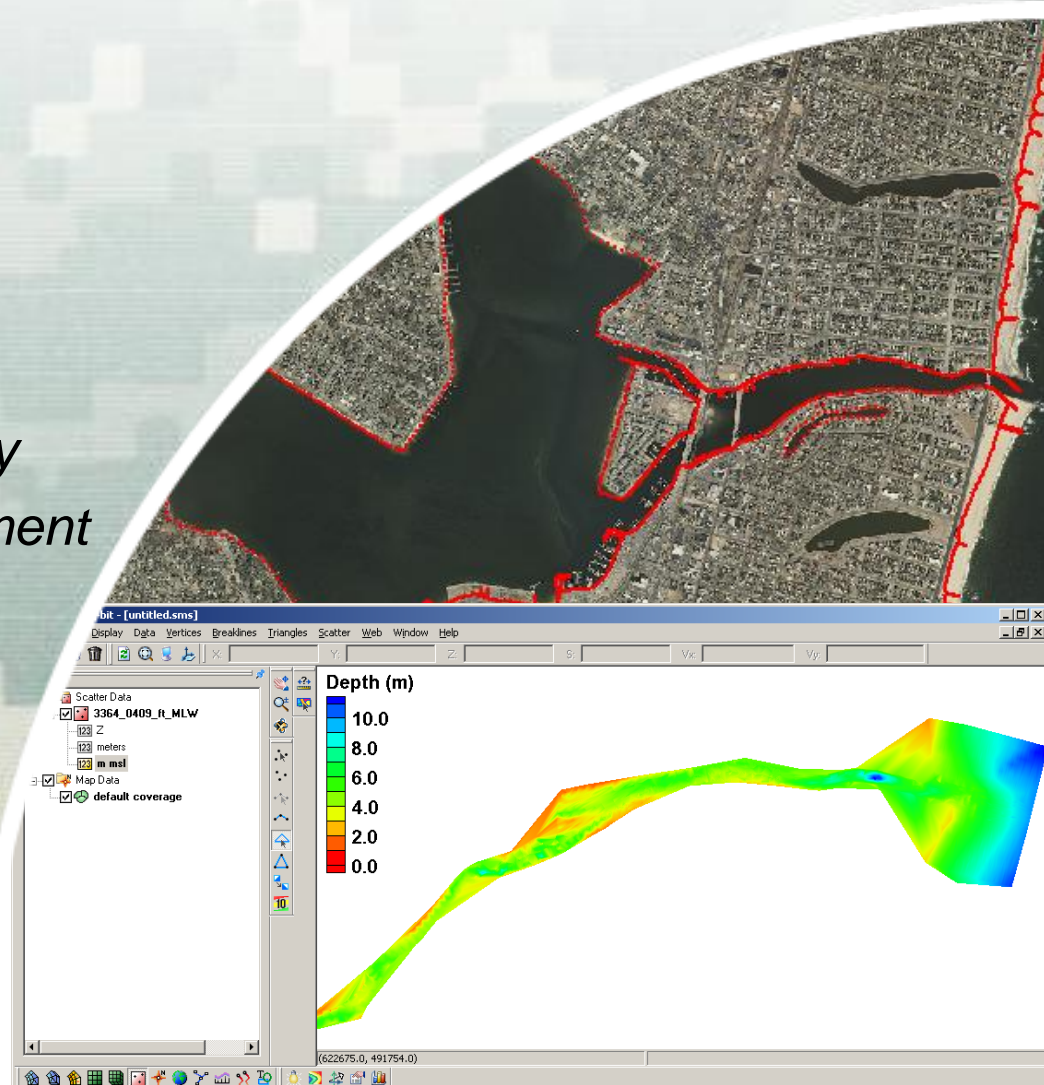
Tanya Beck

*Coastal and Hydraulics Laboratory
Engineer Research and Development
Center*

May 17, 2010



US Army Corps of Engineers
BUILDING STRONG®

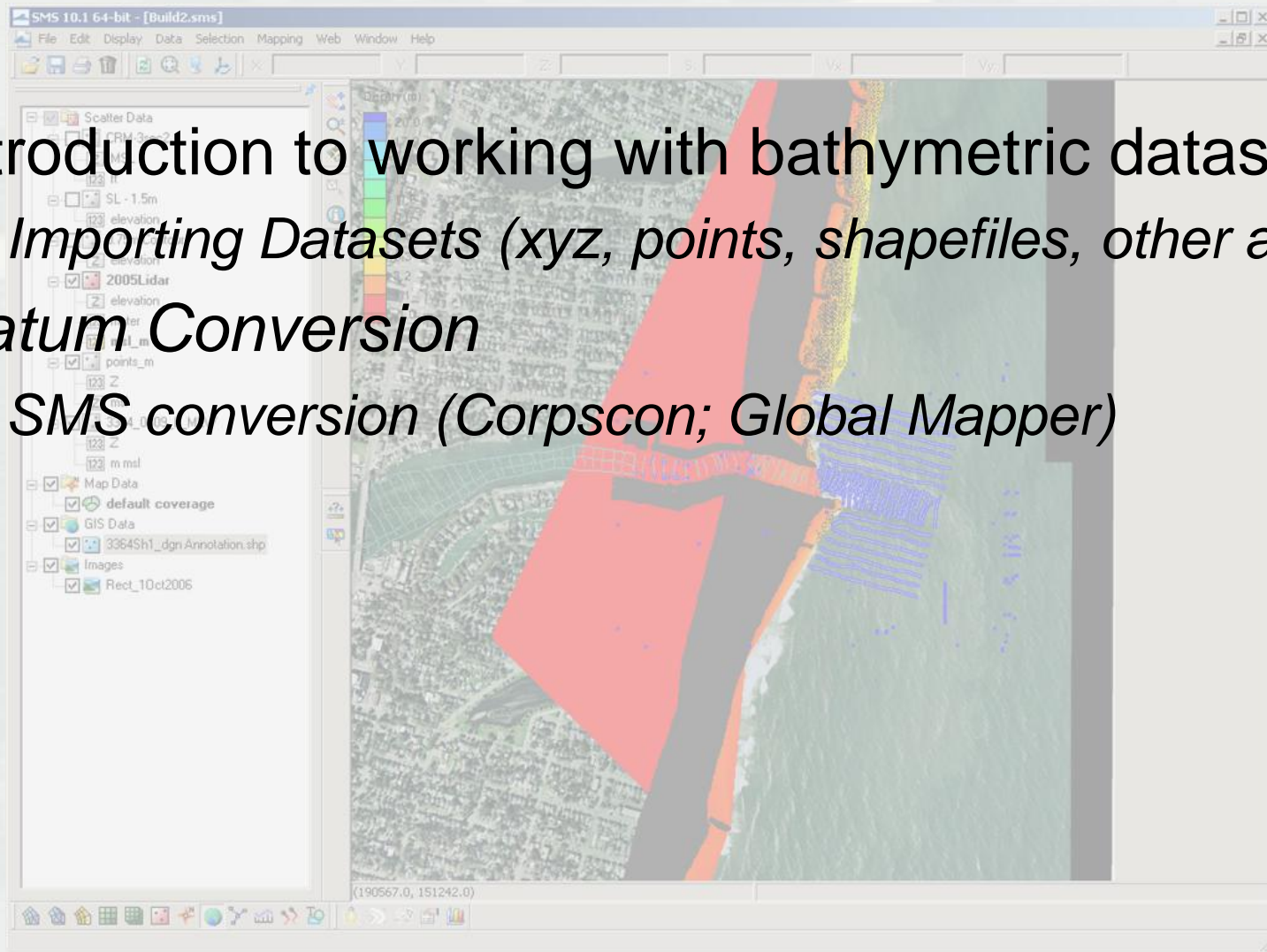




Introduction to Bathymetric Databases in SMS



- Introduction to working with bathymetric datasets
 - ▶ *Importing Datasets (xyz, points, shapefiles, other ascii)*
- *Datum Conversion*
 - ▶ *SMS conversion (Corpscon; Global Mapper)*

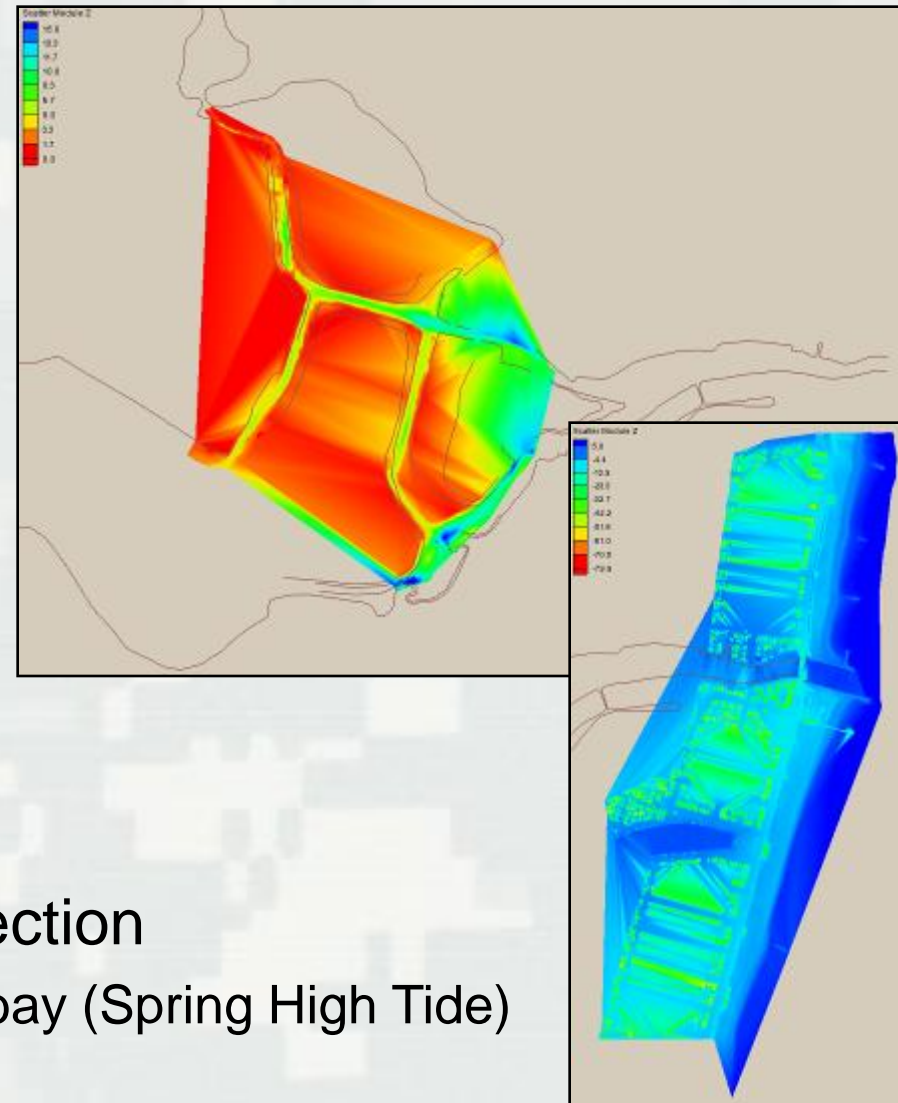




Multiple Bathymetric Datasets

CIRP

- Limited bay bathymetry
- NOAA – Offshore datasets
- LIDAR – Shoreline and nearshore (important for structure resolution)
- Channel
 - ▶ NJ State maintains north channel and north bay channel
 - ▶ Federally maintained entrance and south channel (15 years)
- NAN-supported field data collection
 - ▶ Included bathymetry of the backbay (Spring High Tide)



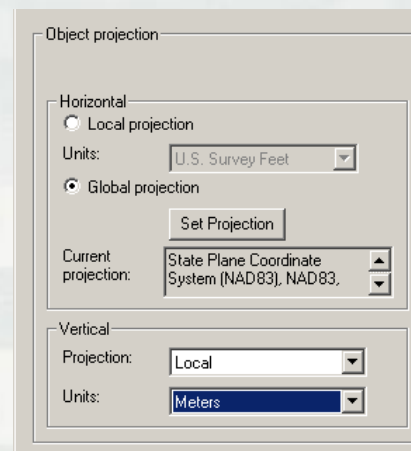
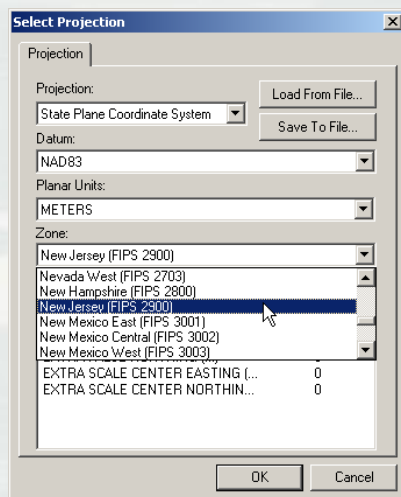
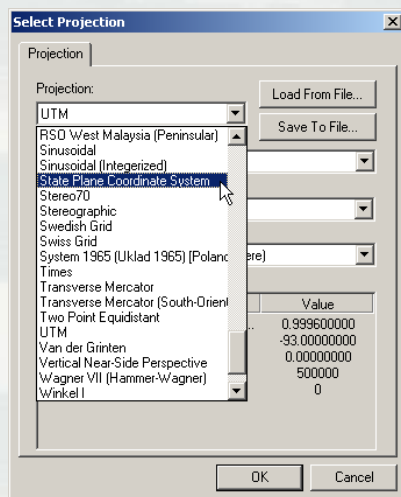


Common Spatial Reference Datum & Vertical Datum

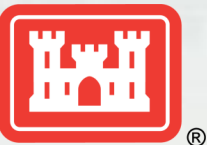
CIRP

Horizontal Projection & Datum:
Pick a system in metric units that is
planar (UTM; State Plane)

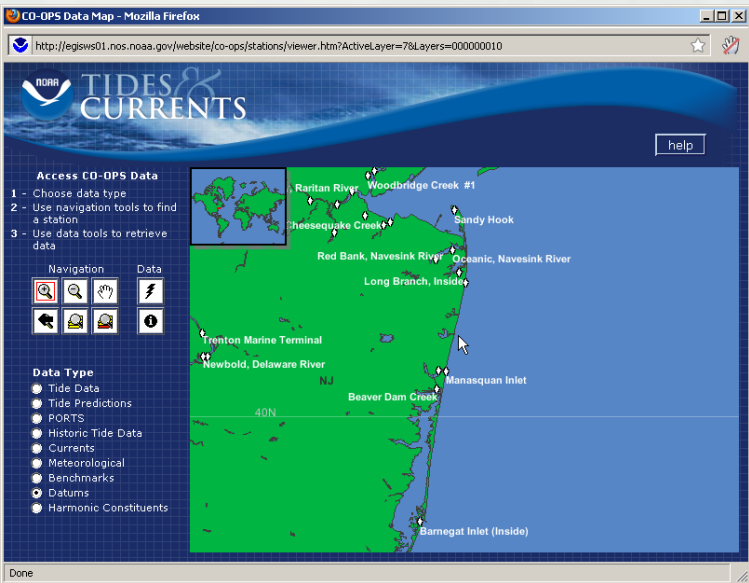
Vertical Projection & Datum: Must
be in metric as well; Datum is not
necessary (Local)



...Need to convert all bathymetric data



Tides and Currents (NOAA)



Data Retrieval

LONG BRANCH, ISHING PIER, NJ
Station ID: 8531991

Datums
Click [HERE](#) for printable version

Data Units:
☒ Feet ☐ Meters [Apply Change](#)

May 5 2010 14:45

ELEVATIONS ON STATION DATUM
National Ocean Service (NOAA)

Station: 8531991
Name: LONG BRANCH, FISHING PIER, NJ
Status: Accepted

T.M.: 75 W
Units: Feet
Epoch: 1983-2001

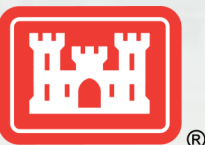
Datum	Value	Description
MHHW	23.93	Mean Higher-High Water
MHW	23.59	Mean High Water
DTL	21.46	Mean Diurnal Tide Level
MTL	21.39	Mean Tide Level
MSL	21.44	Mean Sea Level
MLW	19.19	Mean Low Water
MLLW	19.00	Mean Lower-Low Water
GT	4.93	Great Diurnal Range
MN	4.40	Mean Range of Tide
DHq	0.34	Mean Diurnal High Water Inequality
DLq	0.19	Mean Diurnal Low Water Inequality
HWI	12.26	Greenwich High Water Interval (in Hours)
LWI	6.04	Greenwich Low Water Interval (in Hours)
NAVD	21.68	North American Vertical Datum
Maximum	27.13	Highest Water Level on Station Datum
Max Date	19870102	Date Of Highest Water Level
Max Time	09:12	Time Of Highest Water Level
Minimum	14.40	Lowest Water Level on Station Datum
Min Date	19780110	Date Of Lowest Water Level
Min Time	21:00	Time Of Lowest Water Level

To refer Water Level Heights to a Tidal Datum, apply the desired Datum Value.

Click [HERE](#) for further station information including New Epoch products.

To refer Water Level Heights to either
NGVD (National Geodetic Vertical Datum of 1929) or
NAVD (North American Vertical Datum of 1988), apply the values located at:
[National Geodetic Survey](#)

http://tidesandcurrents.noaa.gov/station_retrieve.shtml?type=Datums

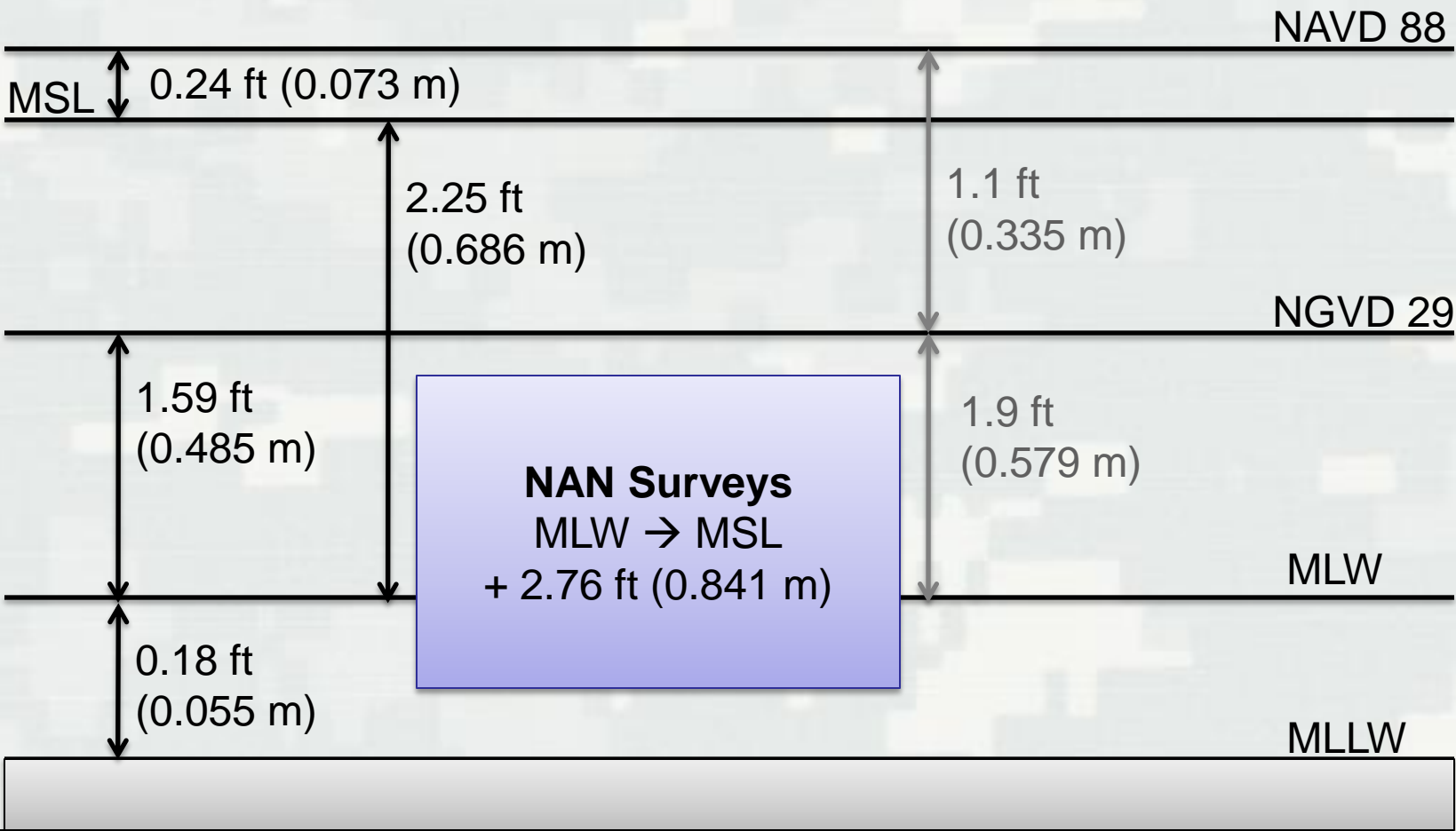


Vertical Datum Conversions



NOAA (Long Branch)

COE NAN Benchmark





Prep for the Coastal Modeling System



- Based off of a Cartesian grid
 - Planar coordinate system
 - Model computation is in metric and depths are positive from zero (elevations are flipped)
 - Grid is generated based off of a single bathymetry file stored in SMS scatterset file format
 - Vertical datum is not specified and is assumed local
 - The boundary condition forcing (tidal) must be in the same datum as the bathymetry
 - Typically modeling grids are brought to a mean datum such as mean sea level (msl) or mean tide level (mtl)
- → This requires that all datasets are brought in to unified projection, datum, and units
 - Shark River Inlet bathymetry will be converted to State Plane horizontal coordinates in meters with the vertical datum set to MSL in meters



Reprojecting Coordinates and Changing Datums



Reproject Object

Object projection

Horizontal

☐ Local projection

Units: U.S. Survey Feet

☒ Global projection

Set Projection

Current projection: System (NAD83), NAD83, U.S. Survey Feet

Vertical

Projection: Local

Units: U.S. Survey Feet

Project projection

☒ Specify

Horizontal

☐ Local projection

Units:

☒ Global projection

Set Projection

Current projection: System (NAD83), NAD83, Meters, ZONE = 2900.0

Vertical

Projection: Local

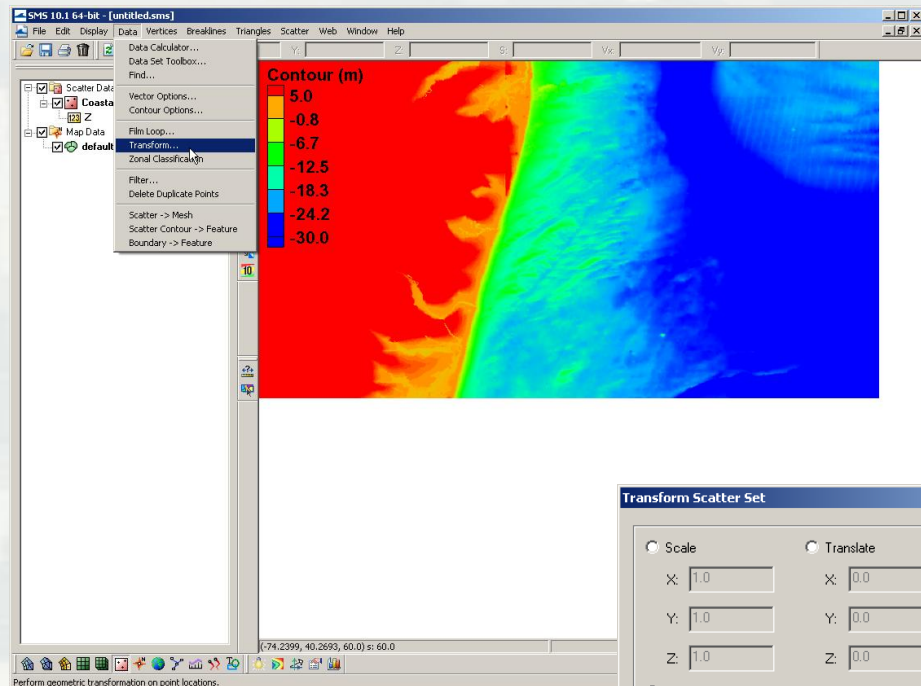
Units: Meters

OK Cancel

Object Projection tells SMS the present projection.
Checking "Specify" Project Projection is used to change the projection.
It will physically change the coordinates of everything loaded in SMS.
The projection settings are saved in the SMS project file (*.sms).

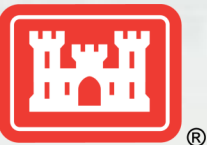


Converting Elevations to Depths (CMS Requirement)



Data → Transform
Can adjust scatterset data by
scaling, translating
(adding/subtracting), or
rotating horizontal or vertical

Select Depths ↔ Elevations
Flips negative elevations to
positive depths.
Necessary for CMS model
calculation.

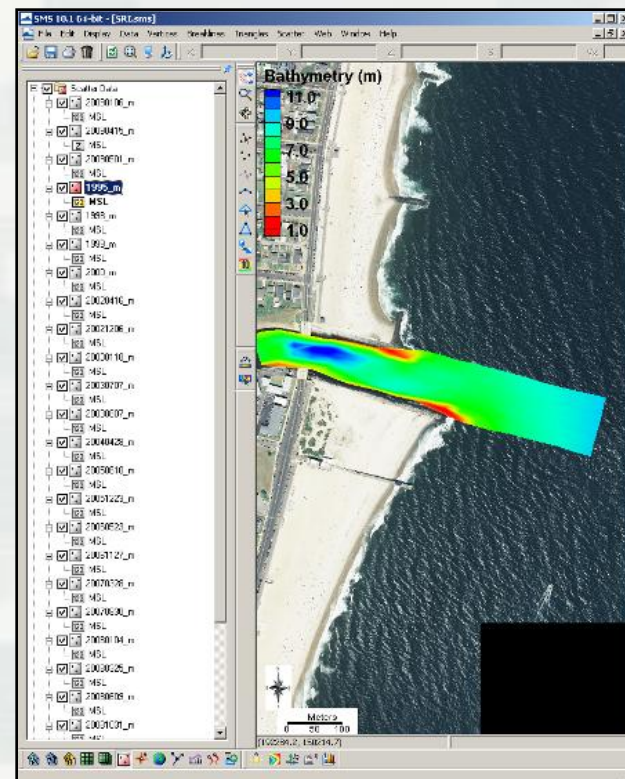


NAN Channel Surveys



15 Year Record of Bathymetry

Date	Survey Type	Date	Survey Type
1-Jan-1995	Condition	28-Mar-2007	Condition
6-Jan-1998	Condition	30-Aug-2007	Before Dredge
6-May-1999	Condition	4-Jan-2008	After Dredge
11-Apr-2000	Condition	25-Mar-2008	Condition
16-Apr-2002	Condition	9-Jun-2008	After Dredge
6-Dec-2002	Before Dredge	31-Oct-2008	After Dredge
18-Jan-2003	After Dredge	8-Dec-2008	Before Dredge
7-Jul-2003	Condition	6-Jan-2009	After Dredge
7-Aug-2003	After Dredge	15-Apr-2009	Before Dredge
28-Apr-2004	Condition	1-May-2009	After Dredge
10-Jun-2005	Condition	20-Aug-2009	Before Dredge
23-Dec-2005	After Dredge	10-Dec-2009	After Dredge
23-May-2006	Condition	6-Jan-2010	After Dredge
27-Nov-2006	Condition		

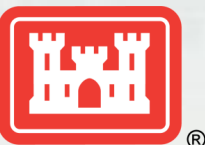


Horizontal Datum:

State Plane NAD27 New Jersey 2900 (ft)

Vertical Datum:

MLW (ft) – COE Datum (not local NOAA benchmark)

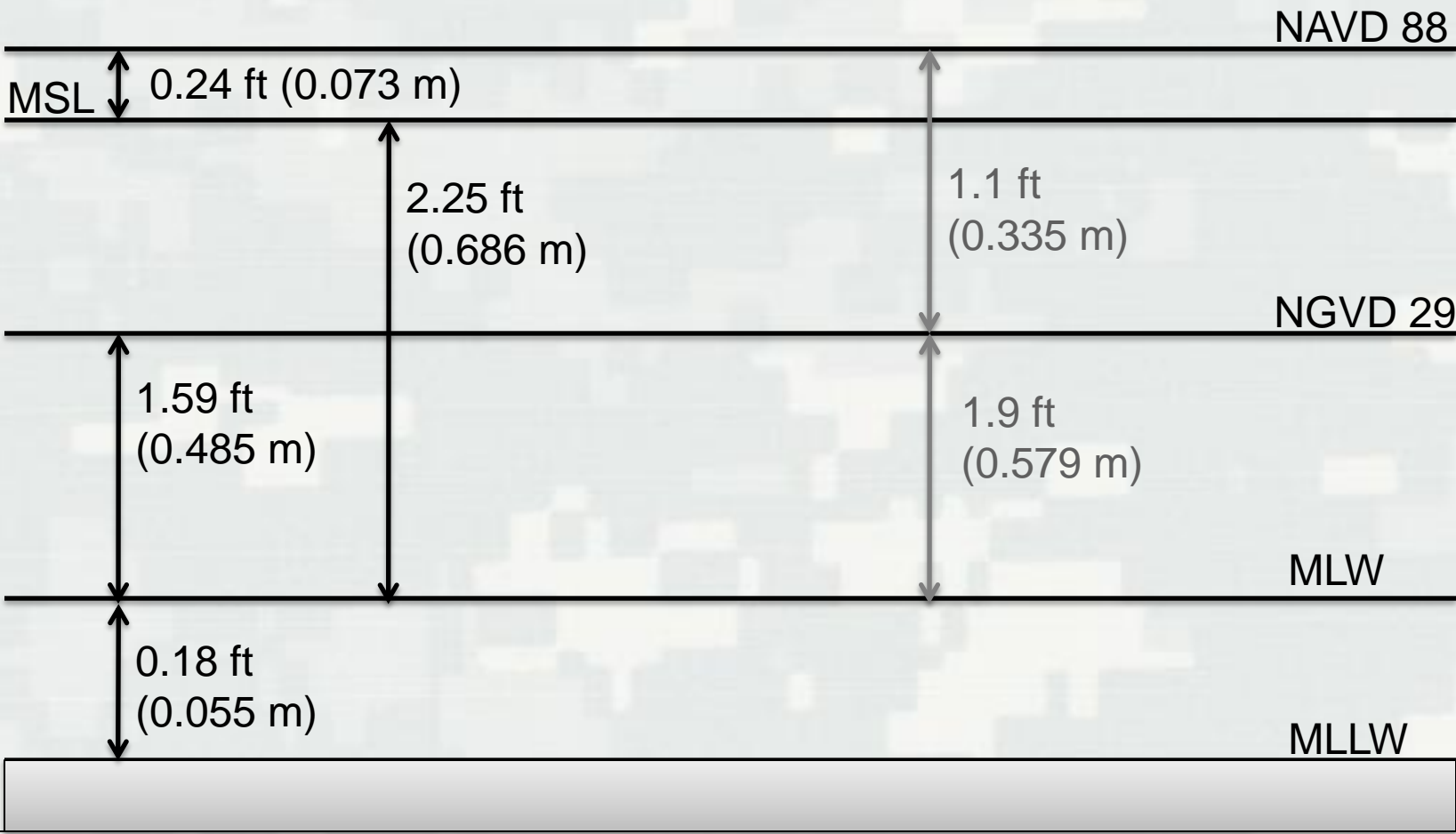


Conversions



NOAA (Long Branch)

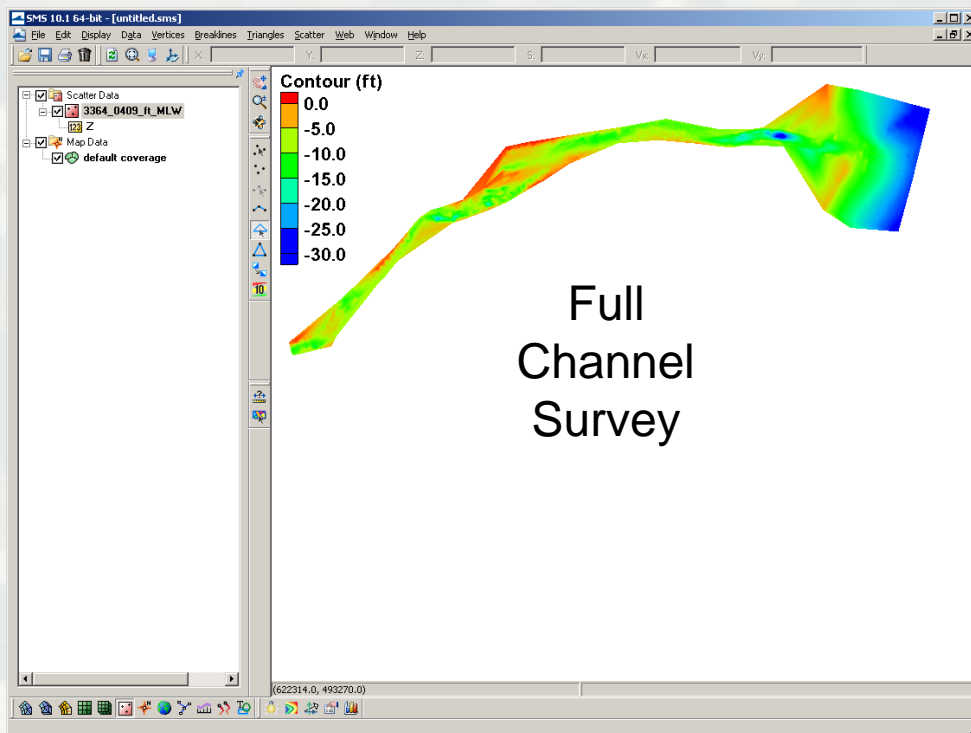
COE NAN Benchmark



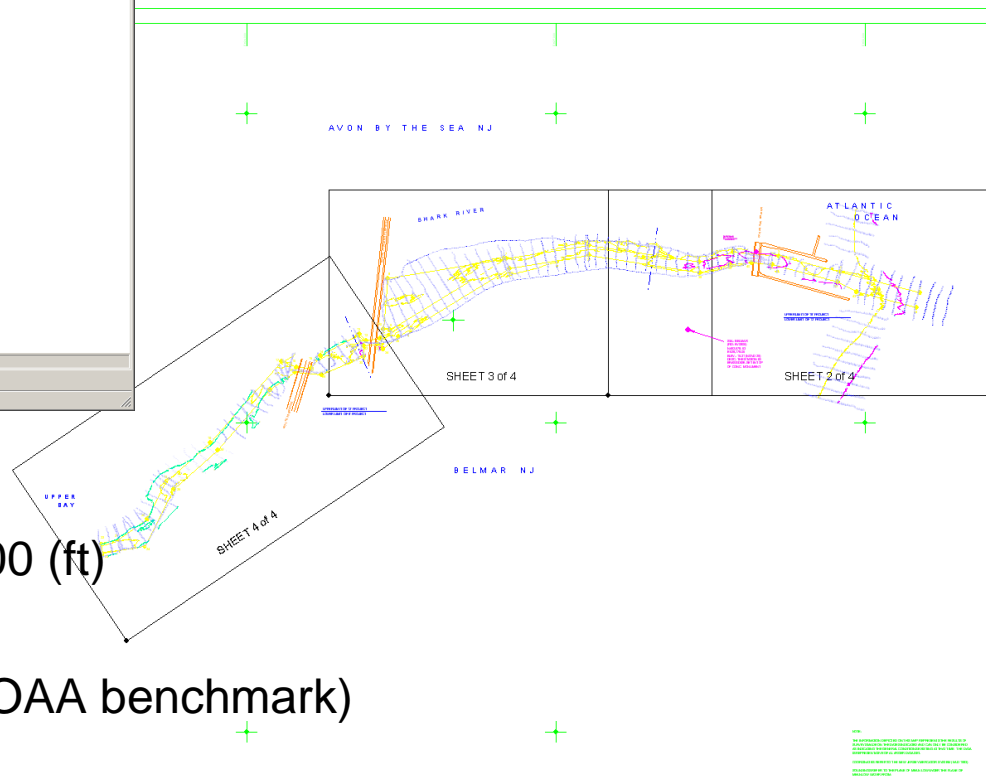


NAN Channel Surveys Extended in to Bay

CIRP



NAN Surveys
MLW → MSL
+ 2.76 ft (0.841 m)



Horizontal Datum:

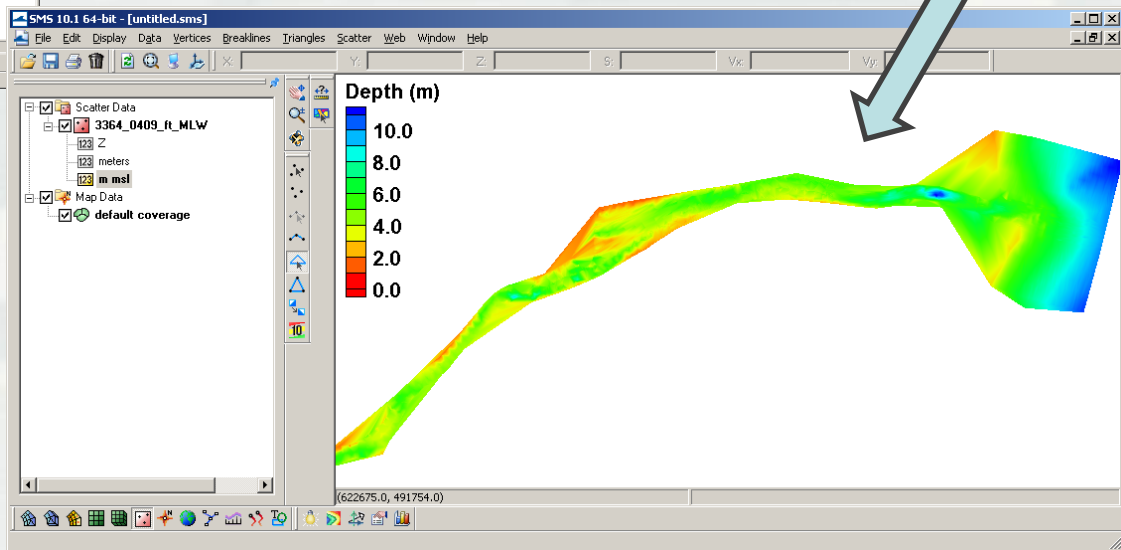
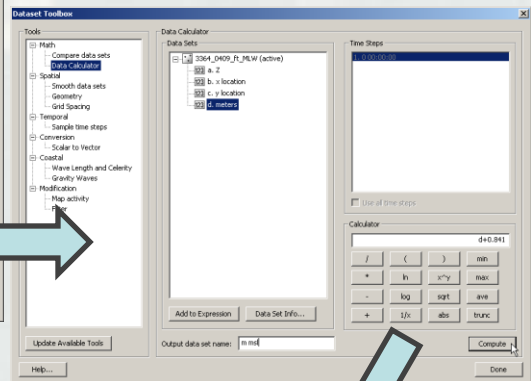
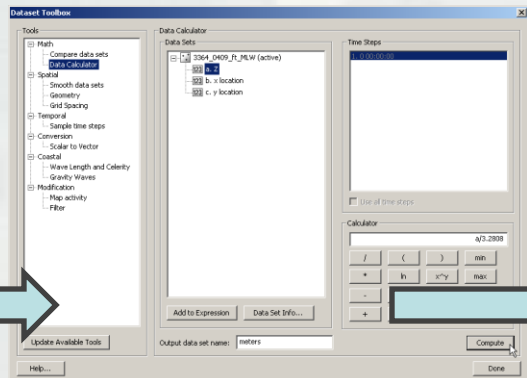
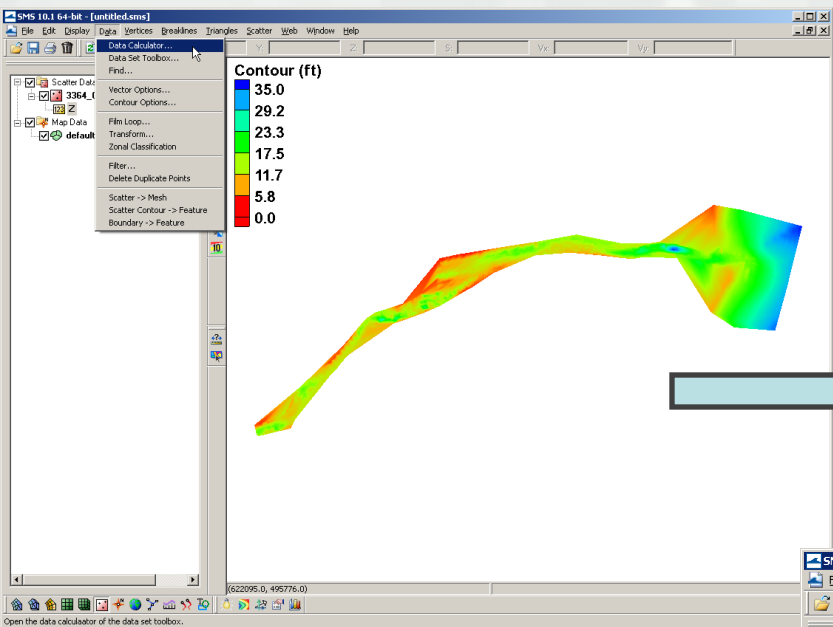
State Plane NAD27 New Jersey 2900 (ft)

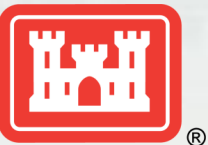
Vertical Datum:

MLW (ft) – COE Datum (not local NOAA benchmark)

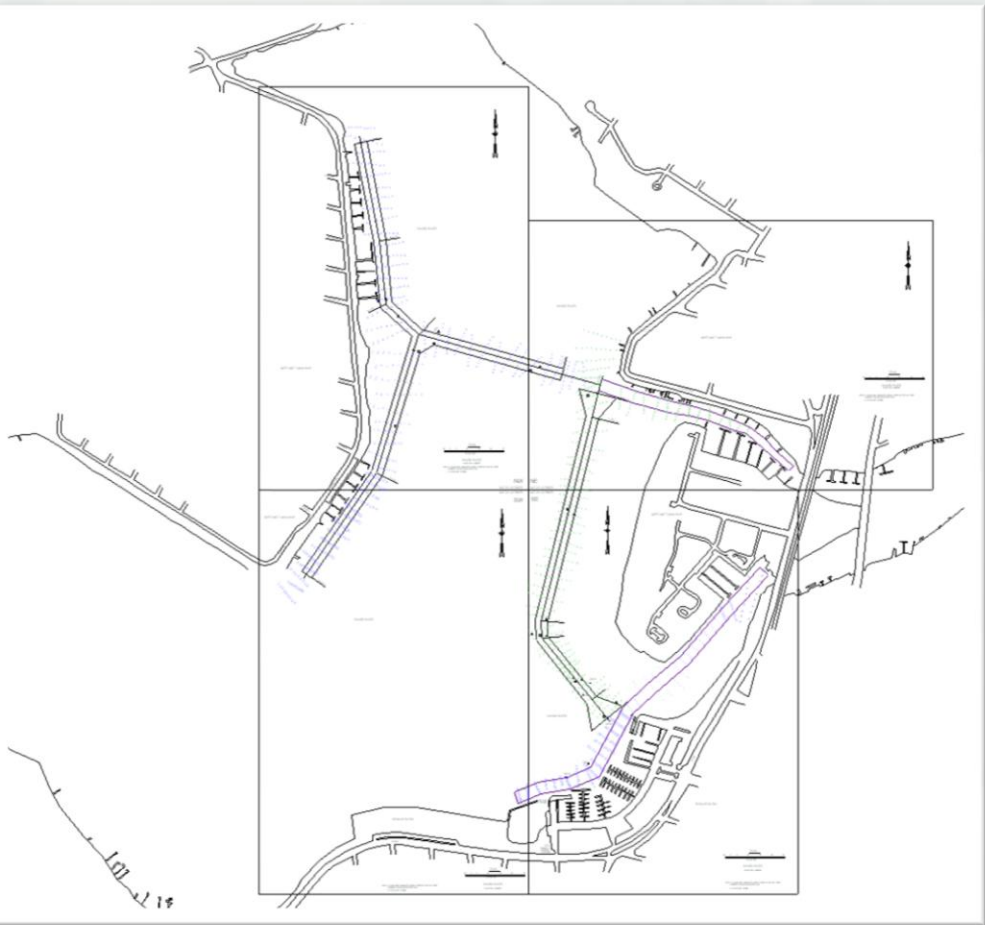


Dataset Calculator

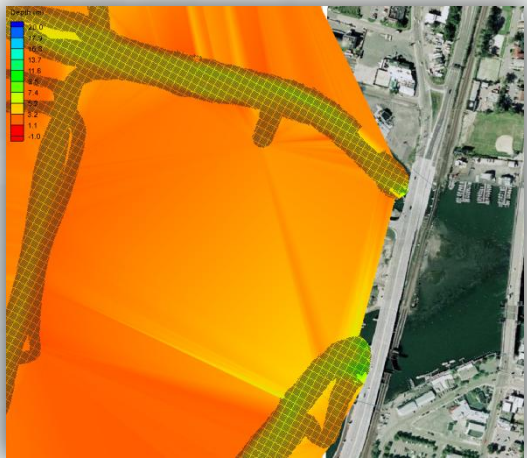




NJ DEP Channel Surveys



June 2009
Survey



Provided conversion from local datum
to NAVD88:

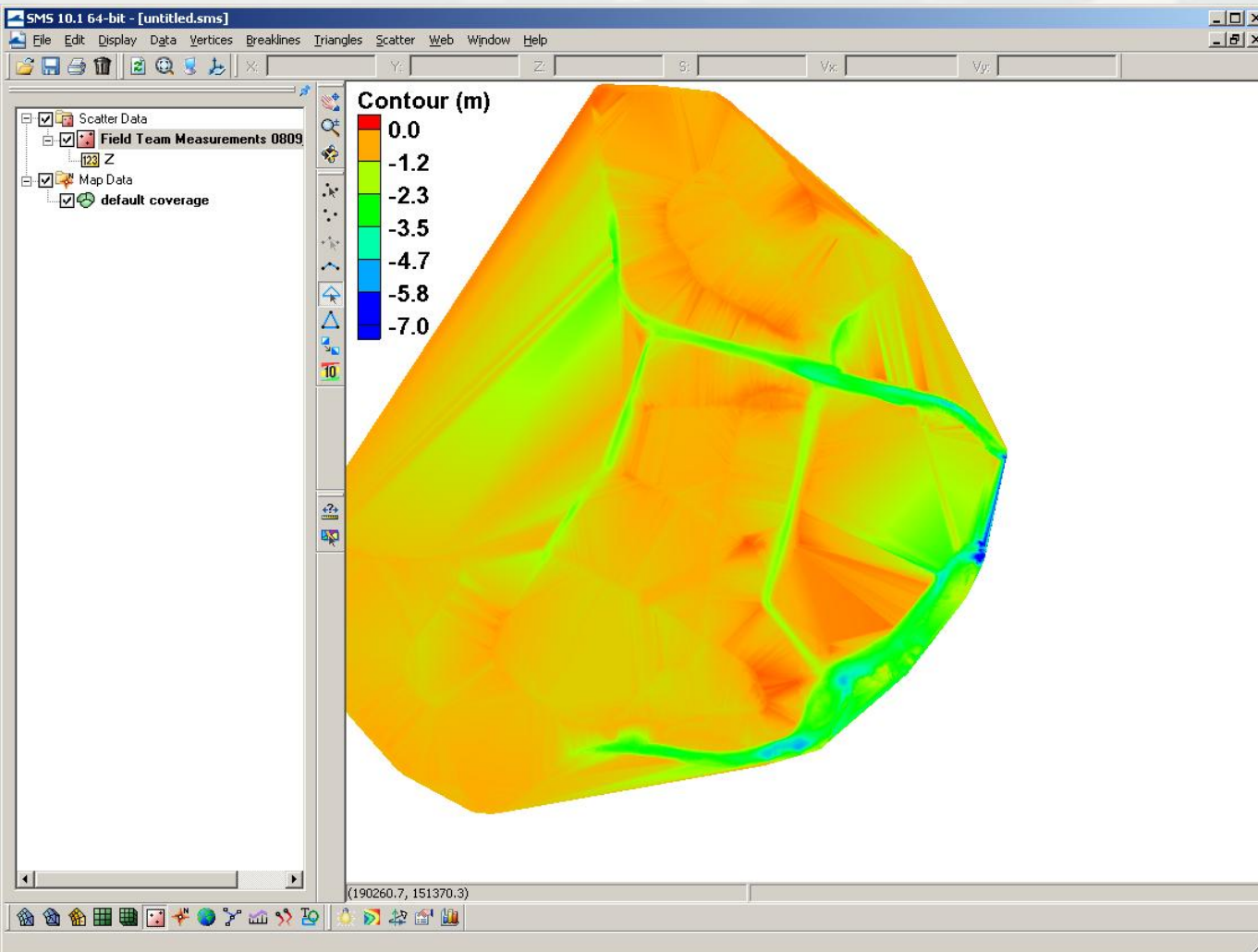
MLW → NAVD88
+ 2.41 ft (0.735 m)

MLW → MSL
+ 2.17 ft (0.661 m)

XYZ pulled out of drawing and
changed to ascii format



Field Data Collection – Multibeam Bay Bathymetry (August 2009)



Horizontal Datum:
State Plane
NAD83 New
Jersey 2900 (m)
Vertical Datum:
NAVD88 (m)



LIDAR



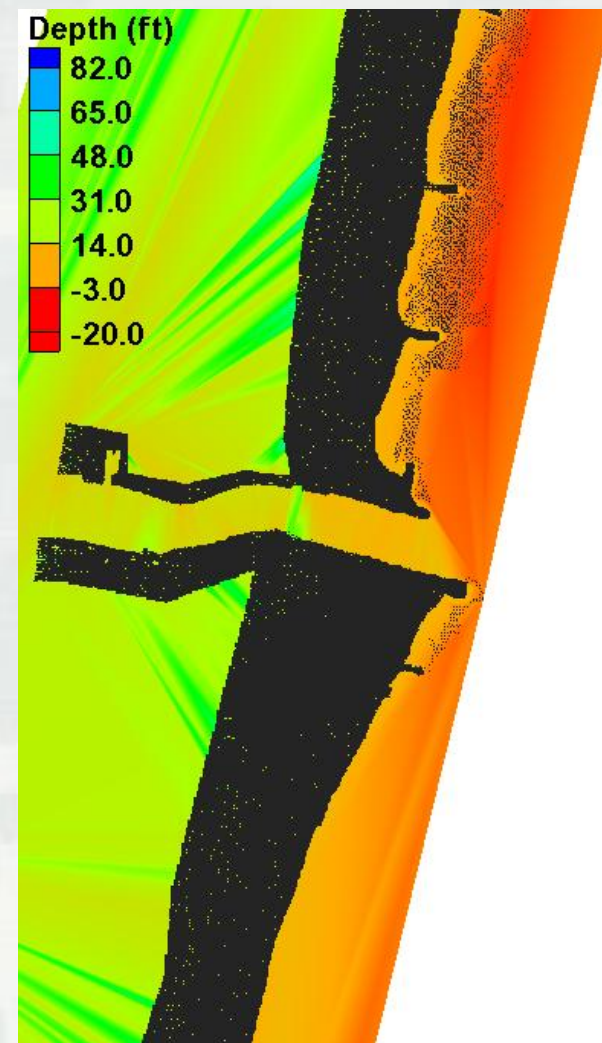
- Files are emailed in separate sections from the NOAA CSC Archive
 - Typically several to 10s of files that are 5 - 100 mb in size
- Compiling takes time
 - Points have been sampled/filtered and cropped to area of interest

Horizontal Datum:

State Plane NAD83 New Jersey 2900 (ft)

Vertical Datum:

NAVD88 (ft)





Coastal Relief Model (DTM/DEM)

CIRP

Bathymetry & Global Relief | ngdc.noaa.gov

NOAA NATIONAL GEOPHYSICAL DATA CENTER

NOAA > NESDIS > NGDC > MGGD > Marine Geology & Geophysics > Bathymetry & Relief

All MGG Coastal DEM Portal Fishing Global Lakes Multibeam NOS surveys

Bathymetry & Global Relief

Scientific stewardship, products, and services for ocean depth data and derived digital elevation models

Bathymetry (Ocean Depths)

- Bathymetric & Fishing Maps
- Great Lakes
- IHO Data Center for Digital Bathymetry (IHO DCDB)
- International Ocean Mapping Projects
- Multibeam Data
- NOS Hydrographic Survey Data
- Satellite-derived Data
- Trackline Data

Combined Bathymetry & Topography

- Coastal Relief & Tsunami Inundation
- Coastlines & Coastline Extractor
- Digital Elevation Model (DEM) Discovery Portal
- Global Relief (ETOPO1, ETOPO2, ETOPO5)

Topography (Land Elevations)

- All Topography
- Global Land 1-km Base Elevation Project (GLOBE)
- U.S. State Images of 30-second Topographic Data
- Lidar Archive

NGDC compiles, archives, and distributes bathymetric data from coastal and open ocean areas, including acting as the long-term archive for NOAA National Ocean Service (NOS) data collected in support of charting and navigation.

NGDC compiles the global ETOPO1 1-minute relief database, coastal relief models for US coastal areas, creates digital elevation models for tsunami inundation research, and stewards gridded topographic data from the GLOBE project.

NGDC participates in numerous international ocean mapping projects, and operates the International Hydrographic Organization (IHO) Data Center for Digital Bathymetry (IHO DCDB) on behalf of the member nations.

Questions: dem.info@noaa.gov

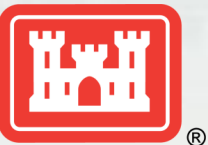
[NGDC Home](#) | [Contacts](#) | [Data](#) | [Disclaimers](#) | [Education](#) | [News](#) | [Privacy Policy](#) | [Site Map](#)

NGDC 3 Arc-Second Coastal Relief Model

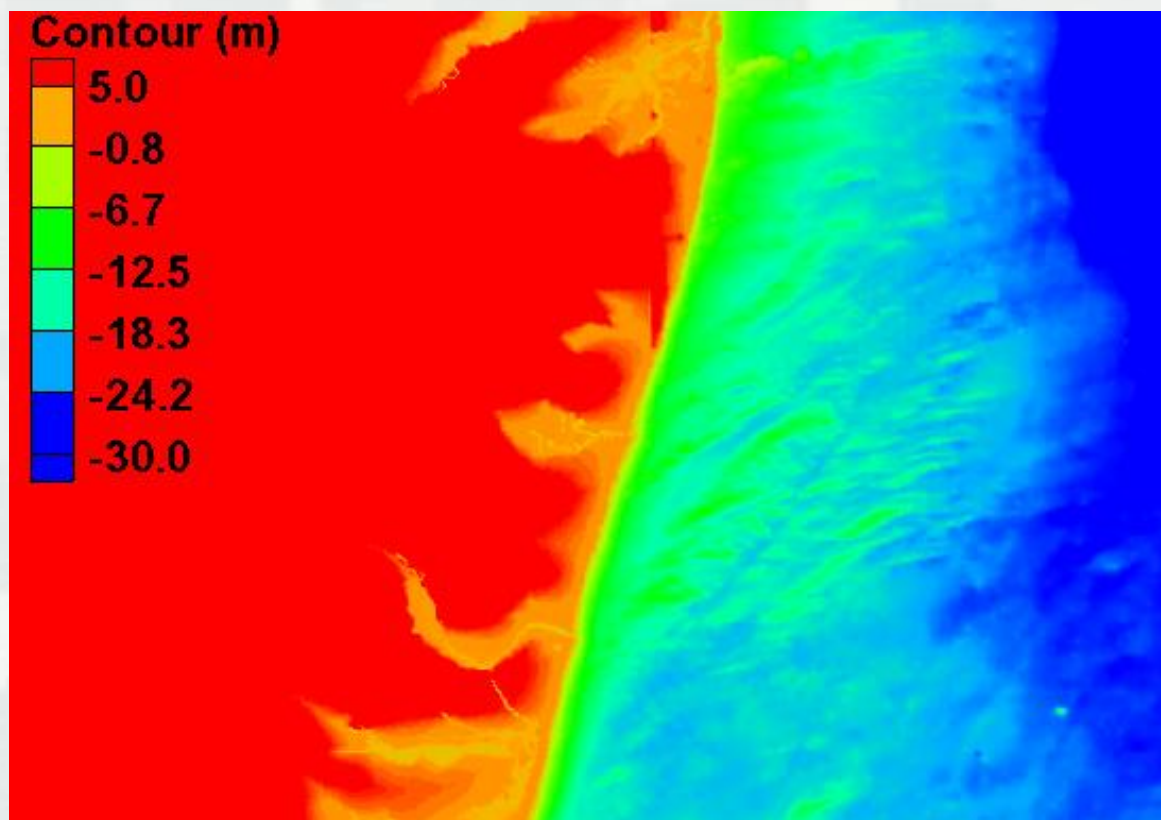
click an area of the map above to view/download images and data

GEODAS Grid Translator - Design-a-Grid

Generate a 3 sec (pt/3rd second) grid



Coastal Relief Model

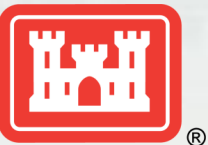


Horizontal Datum:

Geographic NAD83

Vertical Datum:

MSL (m) – Not accurate for shallow bathymetry (used for offshore)



Extra Bathymetry



- Convert shoreline shapefile in SMS

Horizontal Datum:

State Plane NAD83

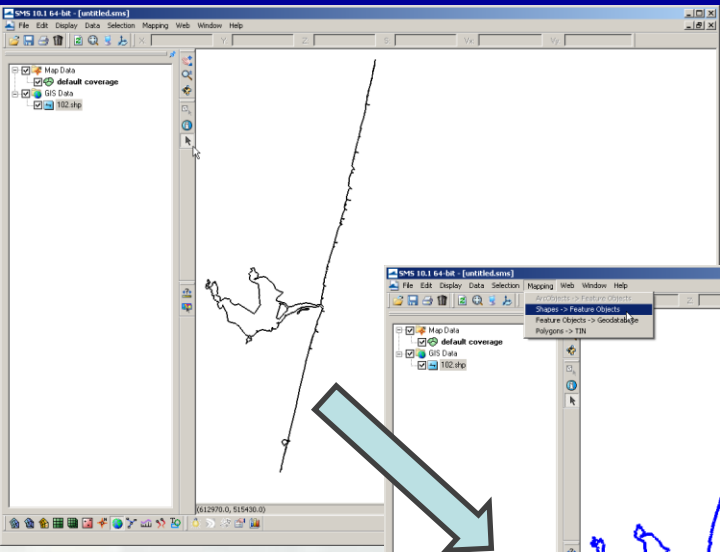
New Jersey 2900 (ft)

- Added extra bay contour (set to -0.75 m)

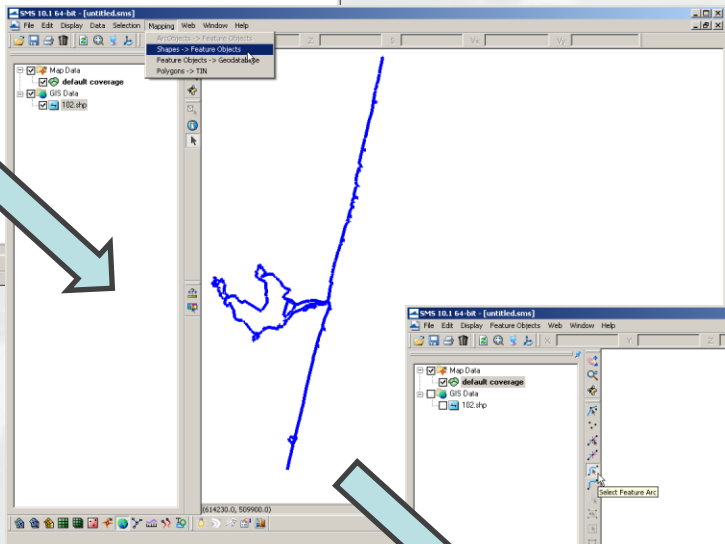
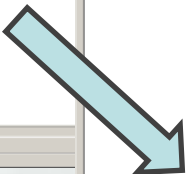




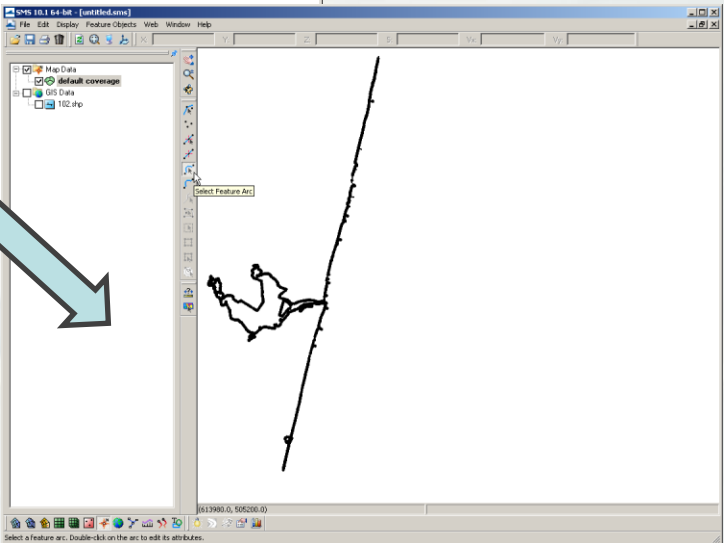
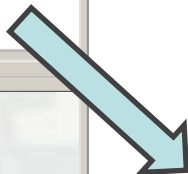
Convert a Shapefile to Map



Drag and drop the shapefile (.shp)



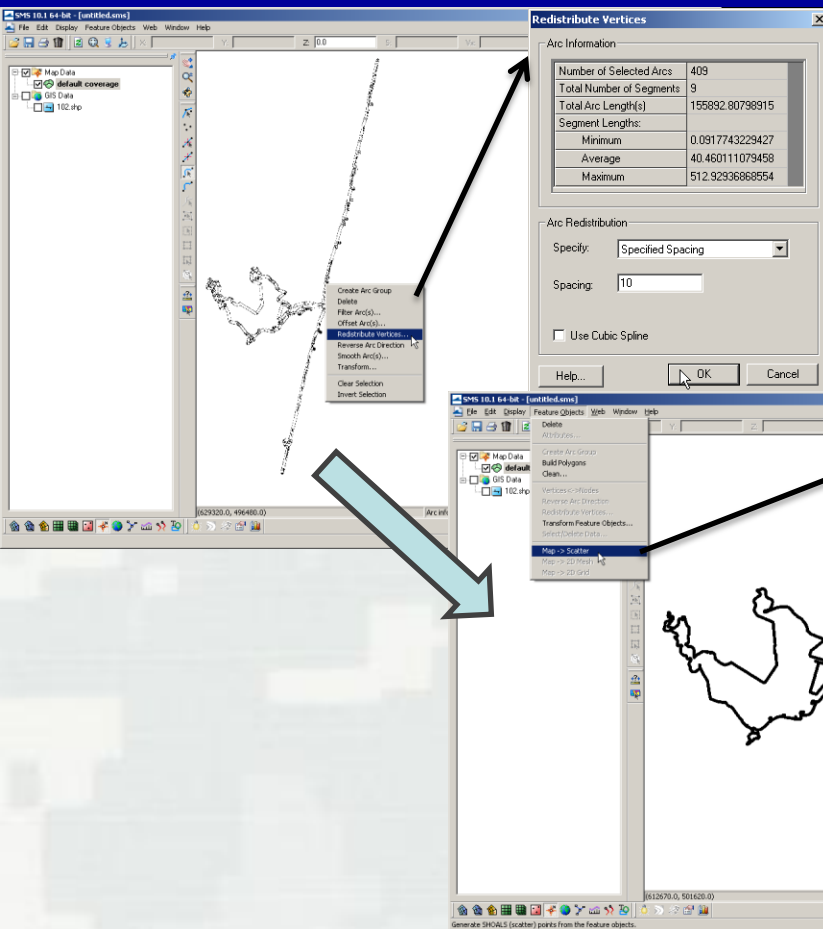
Highlight all Coastline
Mapping – Shapes → Feature
Objects



Turn off GIS Data
Arcs generated
from GIS
shapefile



Convert a Map to Scatter



Highlight all Arcs
Rt-Click → Redistribute Vertices
Specified Spacing (spacing in spatial coordinates)

Feature Objects
Map → Scatter
Include all feature points and vertices (vertices spacing was set to 10)

Modify as necessary (i.e. remove entrance channel shoreline because it is old seawall and jetty configuration – LIDAR used here)

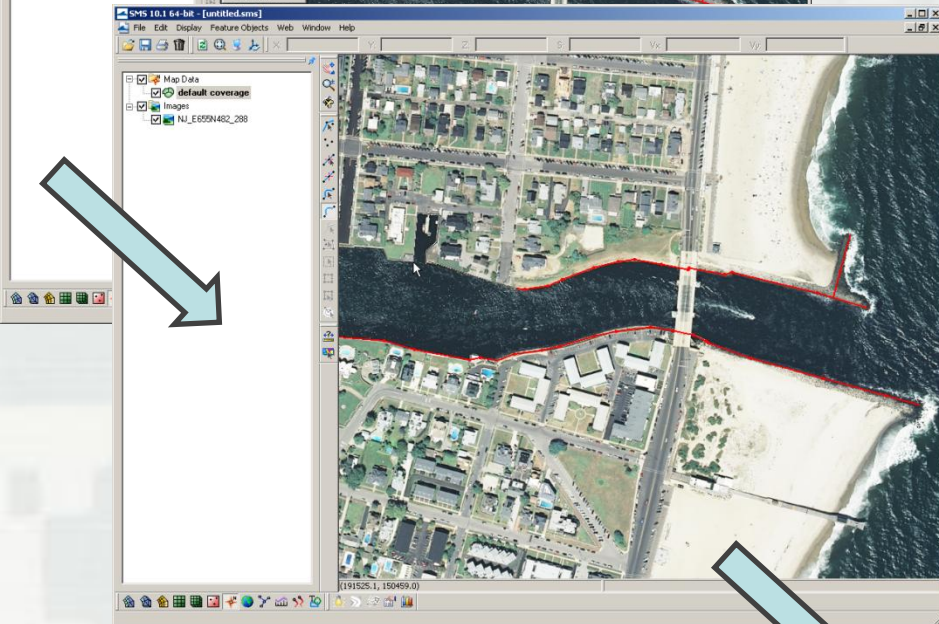



Create a Contour Polyline in the Map Module

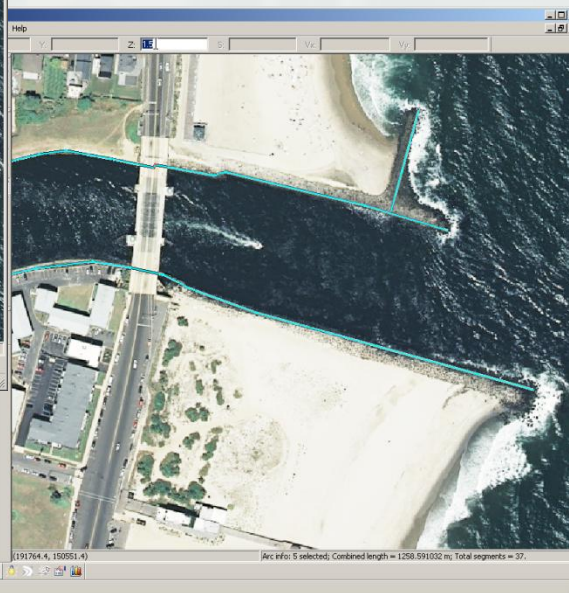
CIRP




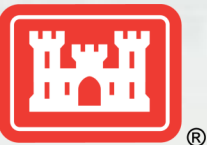
Select Default Coverage under Map Data
Type → Generic → Mapping/Observation/Shoals



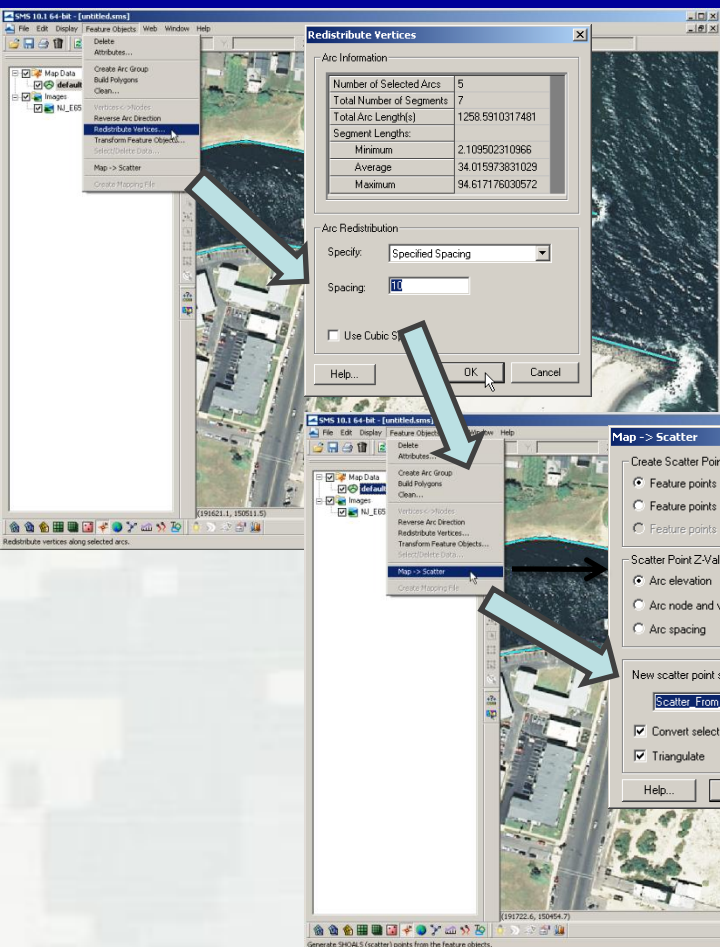
Draw arcs (polylines) feature
with  tool



Select arcs 
and convert the z
elevation to the
desired contour
elevation

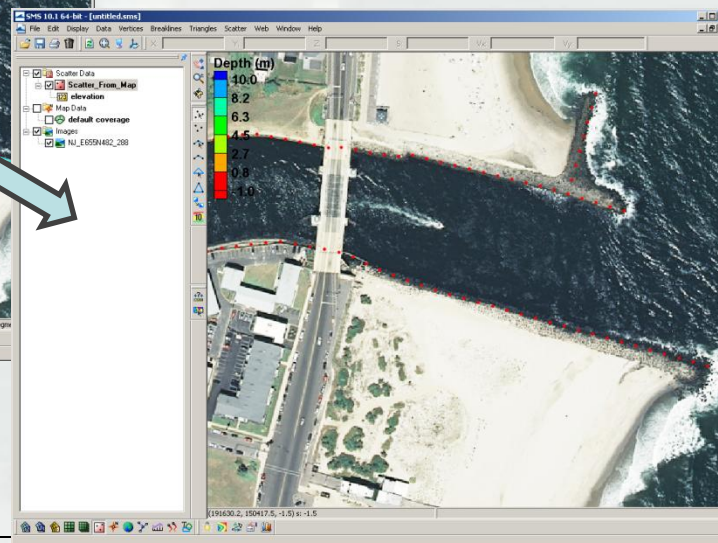


Create Scatterset Points from Map Data



Select arcs to redistribute the spacing of vertices
Feature Objects → Redistribute Vertices
Specify Spacing based on horizontal coordinate system units (metric in this case)

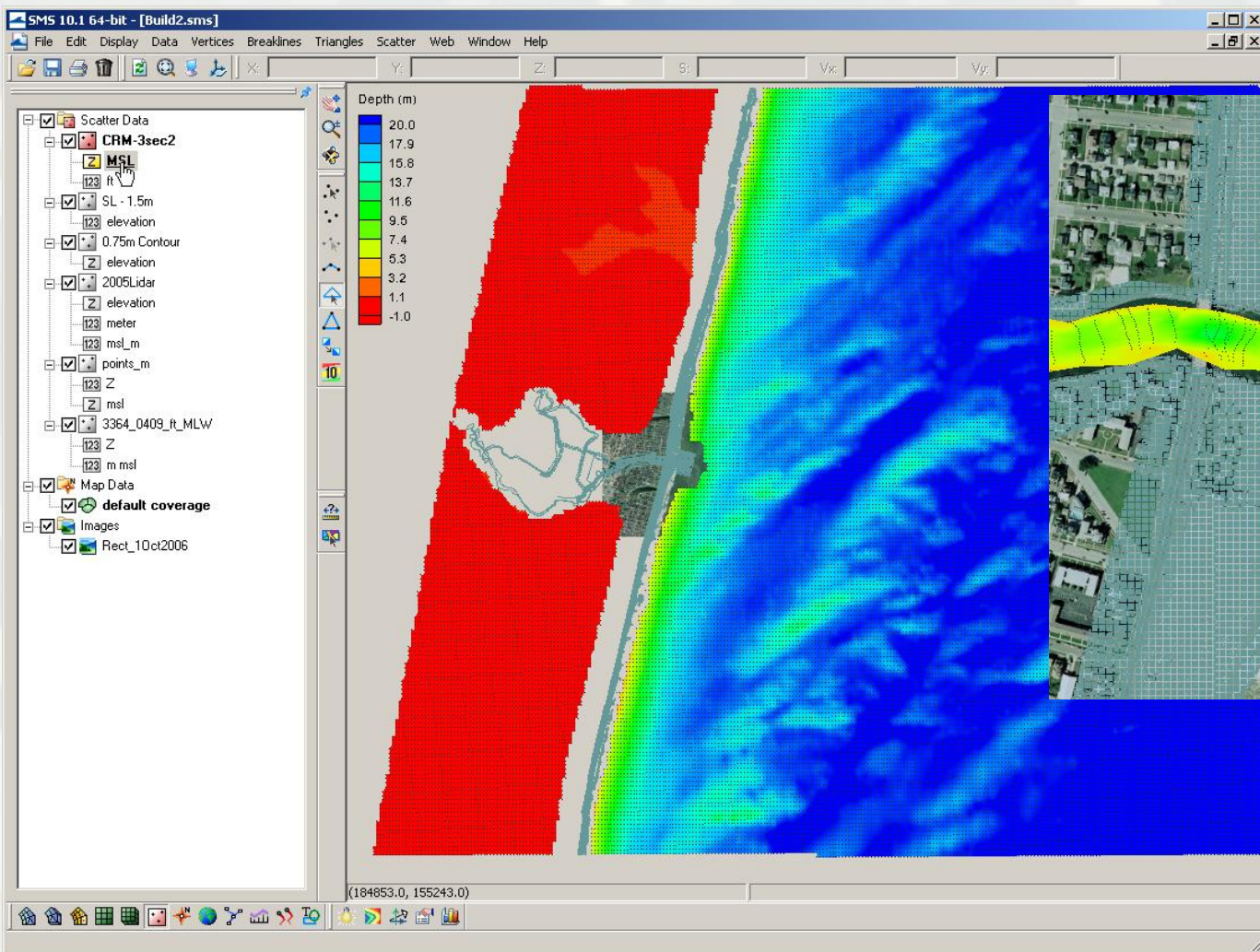
Feature Objects → Map>Scatter
Include Feature Pts and vertices and the Arc Elevations





All Files Referenced to Same Horizontal and Vertical Datum

CIRP

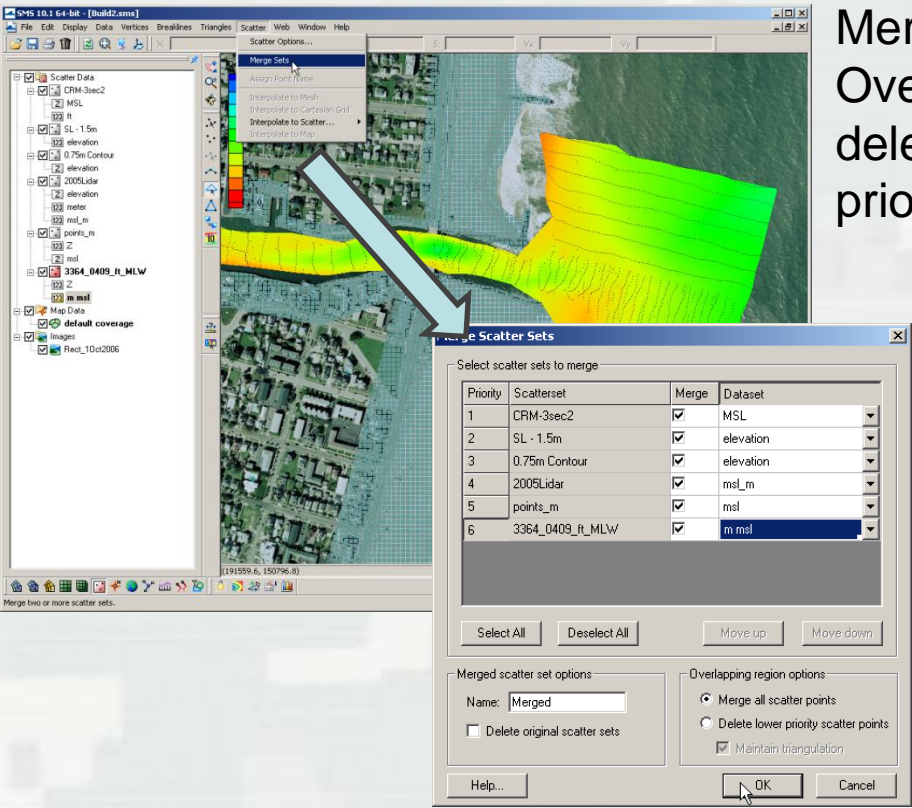


Delete unnecessary data points (check alignment and elevations in overlapping datasets)

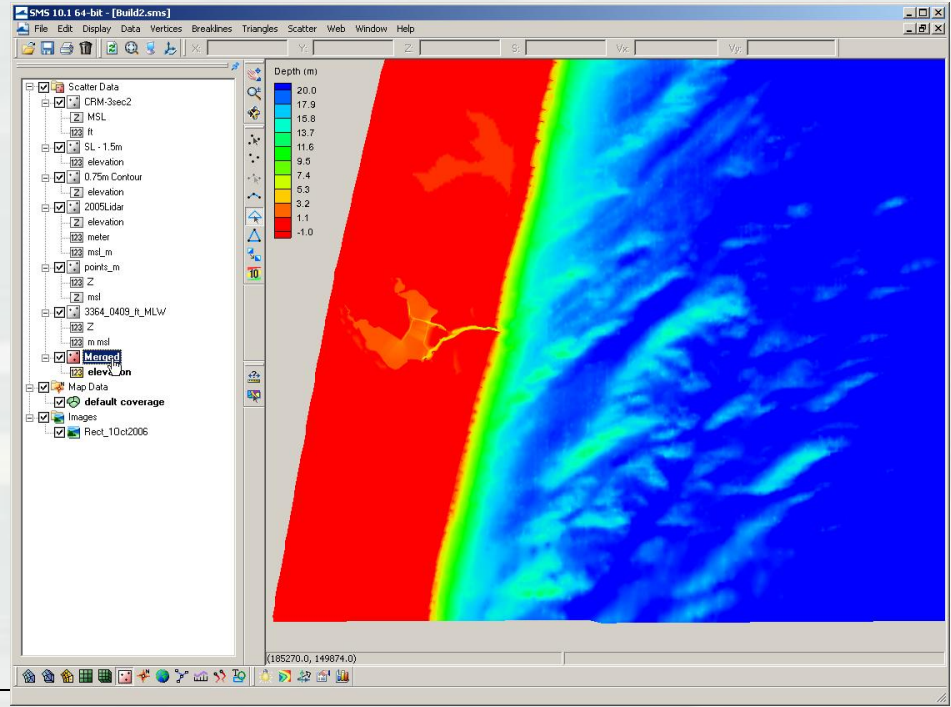


Merging Scattersets

Merging all scattersets will integrate all points. Overlapping areas of scattersets should either be deleted, or use a separate method of merging (by prioritizing using triangles).



Select the dataset





Questions?

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601-634-2603

Or

Mitch Brown

Mitchell.e.brown@usace.army.mil

601-634-4036